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DISTRIBUTION OF DICTYOSTELID CELLULAR SLIME MOLDS IN TWO GRAZING LAND SOILS IN URUGUAY

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ABSTRACT - The distribution and organization of the Dictyostelid cellular slime molds community of 2 grazing lands at Canelones (Uruguay) were studied along a year: Site A under grazing and site B under rest. Four species new for Uruguay were isolated, *Dictyostelium giganteum* Singh, *D. purpureum* Olive, *Polysphondylium violaceum* Brefeld and *P. pallidum* Olive. *D. giganteum* was the only dominant species isolated during the 4 seasons at site B, and only during spring and autumn at site A. In the former the abundance was 5 times greater than in site A. Correlations with soil moisture and temperature are discussed.

RÉSUMÉ - L'organisation et la distribution des communautés de Dictyostelides ont été étudiées pendant une année dans une région de pâturages située en Uruguay, en un site A en pâturage et un site B au repos. Quatre taxons nouveaux pour l'Uruguay ont été isolés: *Dictyostelium giganteum* Singh, *D. purpureum* Olive, *Polysphondylium violaceum* Brefeld et *P. pallidum* Olive. *D. giganteum* est la seule espèce dominante isolée pendant les 4 saisons au site B et seulement au printemps et à l'automne au site A. Dans ce dernier l'abondance est 5 fois plus faible que dans le site B. Les corrélations de ces résultats avec la température et l'humidité de ces sols sont discutées.

KEY WORDS : Dictyostelids, distribution, grazing land soils, Uruguay.

INTRODUCTION

These organisms were first considered to be coprophylous (Olive, 1902; Raper, 1951); their presence in several kinds of soils was reported, suggesting that forest soils are their primary habitat (Cavender & Raper, 1965a; Cavender, 1973).

Dictyostelids are part of the soil microbial population (Cavender & Raper, 1965a); with nematodes, mites and collembola, they integrate the microtrophic group of organisms and they should be considered as regulators of the fungal and bacterial communities in soil (Swift & al., 1979). They live specially in micr-

ohabitats where great amounts of bacteria are present as these are their food resource.

They should be considered to have an important role in soil economy due to the control they play on bacteria (Sussman, 1956), but the relationships between bacterial and Dictyostelid populations is scarcely known, as their competitive interaction. Dictyostelid cellular slime molds community is interesting to analyze, to understand its relations with the community of other soil decomposer organisms.

Climate is a primary factor for the Dictyostelid cellular slime molds distribution, as it affects the microclimatic temperature and soil moisture, but there are not enough data to demonstrate if its effect is direct or indirect through an edaphic factor or due to intraspecific interaction appearance (Cavender, 1973, 1980). They are favoured by forest habitats with intermediate moisture levels (Cavender & Raper, 1968) and relationships between Dictyostelids species distribution and higher plants are clear.

During the last 20 years, works about geographical distribution of Dictyostelids have been published (Benson & Mahoney, 1977; Cavender, 1973, 1976, 1978, 1980; Cavender & Lakhanpal, 1986; Cavender & Raper, 1965b, 1968; Smith & Keeling, 1968; Sutherland & Raper, 1978; Traub & al., 1981).

The general aim of this work was to determine the composition, structure and seasonal evolution of Dictyostelids community in the A horizon of 2 natural grazing-land soils of Uruguay, one under grazing and another under rest. The results will help to evaluate the modifications that agricultural and grazing practices introduce in these soils.

On the other hand it is the first work on Dictyostelids done in Uruguay.

STUDY AREA

The study area is located in Canelones Department, north of Montevideo (Uruguay) on highway 11 (34° 40′ latitude south and 55° 45′ longitude west). The climate of the region is temperate-humid and total rainfall during the study period (September 1985 - June 1986) was 1105.8mm.

The soil samples were collected from 2 grazing land sites, with subspontaneous pasture vegetation. One of the sites (site A) is an ochric distric argisol and the other (site B) is a luvic subeurtic brunosol (Altamirano & al., 1976). The selected sites are situated on high slopes with 8% gradient, approximately.

These soils have been cropped for over 100 years and at the moment the vegetation at site A is primarily made up of summer perennial gramineae (with dominance of *Aristida murina*, *Leptocoryphium lanatum* and *Botriochloa laguroides*) with some winter perennials (dominant: *Piptochaetium montevidense*), and weeds (*Richardia stellaris* and *Evolvulus sericeus*, as dominants), and is under strong grazing. The vegetation at site B is similar to the foregoing, with a greater abundance of *Eryngium horridum*, *Baccharis* spp., and specially *Eupatorium buniifolium*; and is under rest.

MATERIALS AND METHODS

At both sites, a transect was done along which 10 samples were taken at 8m intervals. At each site the vegetation was removed over an approximate surface of 400 square cm with a sterilized scalpel. The samples were taken from the first 5cm of the A_1 horizon using a sampling cylinder washed in alcohol between extractions. Four plugs were mixed in a plastic bag until an uniform sample was obtained (Christensen, 1981). The samples were immediately carried to the laboratory and preserved until their processing within 24 hours. Sampling was carried in September, December (1985) and March, June (1986).

The dilution plate technique was carried out starting from 10 grams of dry soil in 90ml sterile distilled water, preparing a second dilution 1:100, manual agitation was used. One milliliter of the final dilution was homogeneously spread on the surface of prepoured plates, with the addition of a *Enterobacter aerogenes* suspension (5 replications for each sample). The culture medium used was glucose-peptone agar (0.25g glucose, 0.25g peptone, 1.8g KH_2PO_4, 0.33g Na_2HPO_4, 20g agar, 1l distilled water) (Benson & Mahoney, 1977).

Plates were incubated at approximately 23°C, under diffuse natural light. They were observed after 4, 6 and 8 days and colonies were identified and counted. When further observation was required for identification, pure culture isolates were made by transferring spores to fresh streaks of *E. aerogenes* on lactose-peptone agar (1g lactose, 1g peptone, 15g agar, 1l distilled water).

The following parameters were calculated: absolute density (number of clones per gram of soil), relative density (isolates of a species as a percent of total isolates) and frequency (the number of samples containing clones by the total number of samples, %).

RESULTS

The composition and organization of the Dictyostelid cellular slime molds taxocene became manifest on the basis of the analysis of 41 isolates, from 80 samples, which revealed the presence of 4 species at both sites. There was a total of 4100 clones g soil, corresponding 500 clones g soil to site A and 3600 clones g soil to site B.

The taxocene was constituted by 2 genera and 4 species: *Dictyostelium giganteum* Singh, *Dictyostelium purpureum* Olive and *Polysphondylium violaceum* Brefeld were found in site A; *Dictyostelium giganteum* Singh, *Dictyostelium purpureum* Olive and *Polysphondylium pallidum* Olive were found in site B.

The relative density of each species in both sites was very different (Tabl. 1), the total number of isolates in site B is 5 times greater than in site A. *D. giganteum* was numerically the most important species found in site B, not being so in site A, where it was very less frequent. *D. purpureum* was found at both sites with few isolates, but its relative density became important at site A because the total number of isolates was very low; it was a minor species. *Polysphondylium violaceum* and *P. pallidum* was also minor species, with 200 clones g/soil and 100 clones g/soil in site A and B respectively.

The distribution of isolates in site A was not homogeneous and they were absent in December and June; the number of clones varied from 300 to 1900/g of soil.

SITE A	SEP.		DEC.		MAR.		JUN.		TOTAL	
	RD	F	RD	F	RD	F	RD	F	RD	F
D. giganteum Singh	100	10							20	2,5
D. purpureum Olive					50	20			40	5
D. violaceum Brefeld					50	10			40	2,5
SITE B	SEP.		DEC.		MAR.		JUN.		TOTAL	
	RD	F	RD	F	RD	F	RD	F	RD	F
D. giganteum Singh	100	10	95	80	85,7	10	100	30	94,4	32,5
D. purpureum Olive					14,2	10			2,77	2,5
D. pallidum Olive			5	10					2,77	2,5

Table 1 - Seasonal distribution of 4 Dyctiostelids species at sites A and B (R.D.: relative density; F: frequency).

Tableau I - Distribution saisonnière des 4 espèces de Dictyostelides aux sites A et B (R.D.: densité relative; F: fréquence).

The taxocene seasonal distribution in site B was influenced by the distribution of *D. giganteum*, the species with the highest relative density. The other species showed an unpatterned distribution. *D. giganteum* has a minimum absolute density at the end of winter (September) with 300 clones g soil, and a maximum at the end of spring (December) with 1900 clones g soil; its absolute density in summer and autumn (March, June) was nearly the same, 700 and 600 clones g soil respectively. At site A species appears only at the end of winter (September) with 100 clones g soil.

DISCUSSION

Four species of Dictyostelid cellular slime molds, new for Uruguay, were found, in the A horizon of 2 soils with different conditions. They were *Dictyostelium giganteum* Singh, *Dictyostelium purpureum* Olive, *Polysphondylium violaceum* Brefeld and *Polysphondylium pallidum* Olive.

At site A no isolates were found during spring and autumn, contrary to Cavender & Raper (1965a) who found the greatest number of isolates in these seasons. Anyhow the total number of isolates along the year is very low compared with those found for grassland soils in Kansas (Smith & Keeling, 1968). At site B isolates were obtained all over the year. The greater amount of clones was found at the end of spring (December).

Dictyostelid cellular slime mold populations in grassland soils seem to be correlated with the available soil moisture. Some amoeba need high humidity for a rapid growth. Prairies lack the tree canopy and the litter layer that keep humidi-

ty, as in forest soils. The capacity of prairie soils to retain water is probably more important in species distribution than total rainfall (Sutherland & Raper, 1978).

Site A heavily grazed, lacks any vegetation taller than 20cm and litter is missing. This may cause a great variation in moisture and temperature condition, which could explain the fewer number of clones isolated all over the year. Meanwhile in site B, at rest, the soil is protected by a higher vegetation (nearly 1m) which could keep more stable moisture levels. At this site more isolates (x5) are found than in site A, showing its maximum at the end of spring as it should be expected (Cavender & Raper, 1965a). These findings agree with those of Smith & Keeling (1968) in Kansas, where tall-grass prairies had more species than short-grass ones. Soils protected from desiccation are a best habitat for Dictyostelids which need a high relative humidity and an optimum temperature of 20-23° C (Cavender & Raper, 1965a).

Dictyostelium giganteum, dominant species at site B and isolated only once at site A, has been found also as a dominant species in mesic prairies and codominant with *Polysphondylium violaceum* in wet-mesic-prairies (Sutherland & Raper, 1978). The former is also abundant in subtropical deciduous forests where the vegetation is disturbed by human interference (Cavender & Lakhanpal, 1986). It is a species of wide distribution with a "weedy" behaviour responding to soil conditions such as those caused by agricultural activity (Hammer (1984) *in* Cavender & Lakhanpal, 1986). Its nearly absence at site A may be due to the grazing soil disturbance, and its dominance at site B, to the soil rest conditions. *Polysphondylium violaceum* and *P. pallidum* frequent in temperate regions (Cavender, 1973), minor species herein have unpatterned distribution along the year, as *Dictyostelium purpureum* does.

The data show that Dictyostelid distribution in the grazing lands could be correlated with that obtained by Bettucci & al. (1989) and Bettucci & Rodriguez (1989) at the same sites. They found that abundance of *Trichoderma*, *Penicillium* and its teleomorphs in site B is twice as in site A. This would indicate that Dictyostelids and soil inhabiting fungi, even though their differences, have a similar distribution.

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